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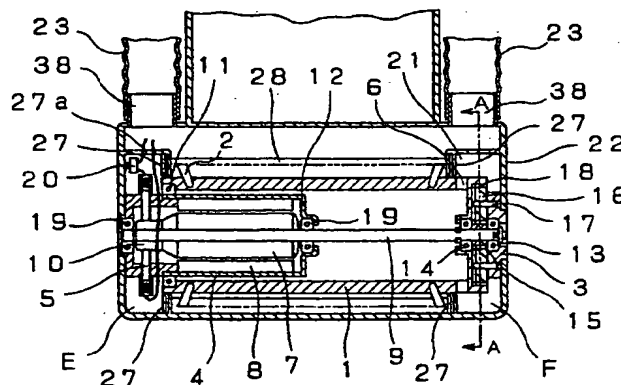
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(54) **Rotary brush device and vacuum cleaner using the same**

(57) A motor is incorporated in a cylindrical body which is a rotary brush. Rotation of a rotor of the motor, directly or via a speed reduction mechanism, drives the rotary brush. Cooling air runs through the cylindrical body so that the motor is cooled and protected. The rotary brush and an electric apparatus using the rotary brush can be downsized and easily.

**Fig. 2**



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objectives or applications. Numeral 3 denotes a reduction gear bracket which is a part of speed reduction mechanism, and a motor bracket 4 holds a motor housed in cylindrical body 1. First opening 6, a ventilation hole, is provided on an edge portion of the outer wall of cylindrical body 1. Numeral 32 denotes a ventilation hole provided in motor bracket 4. The bristle arrangement of brush 2, or agitator, is not limited to the V-shape, but may be of a helical shaped or another patterns for an improved capacity of dust agitation/collec-  
tion.

[0007] In Fig.2, numeral 7 denotes a rotor of the motor, stator 8 of the motor is mounted inside of motor bracket 4, and is disposed in an annular space between rotor 7 and bracket 4. Rotor shaft 9 rotates together with the rotor 7. Commutator 10 is disposed on an edge portion of rotor 7 and carbon brush 5 slidably contacts the circumference of commutator 10. Rotor 7 is powered through carbon brush 5 and commutator 10. A first bearing 11 receives the outer wall of motor bracket 4 press-fitted in its inner wall, while an outer ring of bearing 11 is press fitted into an inner wall of cylindrical body 1 at its left edge so that cylindrical body 1 is journaled at the motor end. Carbon brush 5 is mounted to part of motor bracket 4 which outwardly protrudes from cylindrical body 1 at the motor side, i.e. the motor bracket is provided outside of first bearing 11. Carbon brush 5 is mounted outside of rotational cylindrical body 1 so that wiring for power is easily provided to carbon brush 5, and so that a worn-out carbon brush could be easily replaced.

[0008] Numeral 12 denotes a third opening provided in the motor bracket 4 at the right end for taking the outside air into the motor for cooling. Numeral 13 denotes a second bearing which is press fitted to reduction gear bracket 3 and supports the right end (opposite end to the motor) of the rotor shaft with the inner ring. Numeral 14 denotes a third bearing the outer ring of which is press fitted to a portion of cylindrical body 1 (a recess on the wall opposite to motor of cylindrical body 1), while rotor shaft 9 is press fitted to the inner ring of the bearing. First gear 15 is fixed to the rotor shaft 9, and is held by and between the second bearing 13 and the third bearing 14. Second gear 16 is supported by pin 17 provided in reduction gear bracket 3, for transmitting the rotation of first gear 15 to third gear 18 formed around the inner edge of cylindrical body 1; thus cylindrical body 1 is driven at a reduced speed. Motor bearings 19 are provided at both ends of the rotor 7, the bearings 19 are held by motor bracket 4.

[0009] The structure discussed above allows cylindrical body 11 to rotate in an accurate and smooth manner with less noise and to be journaled by first bearing 11 and third bearing 14. When magnetic permeable material is used to form cylindrical body 11, efficiency of the motor is further promoted. Since heavy items, such as the motor, the reduction gear and its bracket, are placed on both ends of cylindrical body 11 in well balanced

manner, cylindrical body 11 rotates with little wobble thanks to the well-balanced weight. Further, heavy items are placed at both ends, i.e. near to the bearings, so that few chances of rotational wobble are available. Detector 20 detects abnormal pressure in a sucking passage, temperature or electric current and breaks electric supply to the motor; thus the detector is expected to function as a safety device for protecting the motor or preventing unusual heat generation. For instance, when dust is caught in the brush it may lock the rotary brush, and the temperature and the current supply to the motor exceeds a normal level. The detector detects these abnormal states so that the motor is protected and overheating is avoided. Sucked in air is utilized to cool down the motor (detailed later). However, when sucking power is lowered because a filter provided in a dust chamber (48 in Fig. 10) is clogged or the like, the detector detects a lowered pressure in the sucking passage. Since the lowered pressure causes insufficient cooling of the motor, the detector can shut the current-supply to the motor to avoid overheat. Outside-air taking room 21 introduces outside-air to first opening 6 provided on cylindrical body 1. Floor nozzle 22 incorporates the rotary brush therein. A first end of hose 23 is coupled to sucking mouth 38 provided at rear portion of floor nozzle 22. A second end of hose 23 leads to dust chamber 48 and electric blower 43, both are situated in the cleaner body that is disposed behind the floor nozzle (Ref. Fig. 10). Partition 27 is protrusively provided in floor nozzle 22 so that partition 27 surrounds both ends of cylindrical body 1. Partition 27 separates sucking chamber 28, outside-air taking room 28 where first opening 6 is situated and a second opening 32 provided on the motor bracket. Chamber 28 is operated by the sucking power of the electric blower. Partition 27 has communication hole 27a on second opening 32 side, and the sucking operation is obtained through hole 27a, which aims to cool the motor by sucking outside-air through outside-air taking room 21, first opening 6, cylindrical body 1, motor bracket 4 and second opening 32.

[0010] The accompanying drawing in accordance with this exemplary embodiment shows two pieces of hose 23. When only one hose 23 is used, communication hole 27a can communicate sucking chamber 28 so that sucking power directly works through second opening 32. Therefore, the motor can be cooled down more efficiently. In this case, sucking mouth 38 is placed closely to communication hole 27a so that mouth 38 can get strong sucking power. In this case, i.e. with one hose 23, when hose 23 is placed opposite to hole "27a", air sucked through second opening 32 and communication hole "27a" efficiently transfers the dust collected by brush 2 and moved in sucking chamber 28 laterally into hose 23. The placement of hose 23 opposite to communication hole "27a" arranges sucking mouth 38 and first opening 6 on the same side of floor nozzle 22 with regard to lateral direction. The rotary brush is placed in

detects quantity of dusts being sucked into dust chamber 48. The dust detector senses the shift of output from the light-sensing element. The rotation speed of rotary brush 46 is varied in accordance with the dust quantity. Fig. 13(b) illustrates the electrical circuit of detector 63; where, phase controller 64 controls the rotation speed of the motor in accordance with result of the above described dust sensing. When controller 61 selects a rotational speed depending on the dust sensing, phase controller 64 follows the control process discussed above. In addition to this, high, mid, and low speeds are prepared so that users can arbitrarily select the rotational speed among them. This structure allows the vacuum cleaner to be handled with ease and work efficiently in terms of power consumption.

### Claims

#### 1. A rotary brush device comprising:

a cylindrical body having at least one of a brush agitator, a thin-plate agitator and a thin-plate scraper;

a motor disposed in said cylindrical body and for rotating said cylindrical body;

a speed reduction mechanism for reducing rotational speed of said motor; wherein said motor is disposed on a first end of said cylindrical body and said speed reduction mechanism is disposed on a second end of said cylindrical body.

#### 2. The rotary brush device of claim 1 further comprising:

said motor having a rotor;

a commutator provided at one side of said rotor; and

a carbon brush slidably contacts said commutator provided outside said cylindrical body.

#### 3. The rotary brush device of claim 1 further comprising:

said motor having a rotor;

a commutator provided at one side of said rotor; and

a carbon brush slidably contacts said commutator provided inside said cylindrical body.

#### 4. The rotary brush device of claim 3 wherein a first end of the cylindrical body is journaled by a shaft of

the rotor and a second end of the cylindrical body is engaged, via said speed reduction mechanism, with the shaft of the rotor.

#### 5. The rotary brush device of claim 4 wherein the second end of the cylindrical body is supported by an outer ring of a first bearing, into which an inner ring of an outer wall of a motor bracket is press fitted, and wherein at the first end of said cylindrical body, the rotor shaft is journaled by an inner ring of a second bearing, and an outer ring of said second bearing is press fitted into a speed reduction gear bracket.

#### 6. The rotary brush device of claim 5 wherein the speed reduction mechanism further comprises:

a first gear fixed to the rotor shaft;

a second gear rotatably engaged with the first gear;

a third gear disposed on an inner wall of said cylindrical body and the second gear is placed between the first and third gears; and

the speed reduction gear bracket supporting the second bearing and the second gear,

said rotary brush further comprises a third bearing contacting said cylindrical body, wherein the first gear is held and sandwiched by an inner ring of the third bearing and the inner ring of the second bearing.

#### 7. The rotary brush device of claim 1 wherein the motor has a stator, a motor bracket supports the motor disposed in the cylindrical body, and an annular space between an outer wall of the motor bracket, which holds said stator, and an inner wall of said cylindrical body are minimized to allow said cylindrical body to spin.

#### 8. The rotary brush device of claim 7 wherein said cylindrical body is of a magnetic permeable material.

#### 9. A rotary brush device comprising: a cylindrical body with a motor housed in the cylindrical body, an outer wall of the cylindrical body is provided with at least one of a brush, a thin-plate agitator and a thin-plate scraper, the cylindrical body is provided at one end with a first opening for receiving outside air and a second opening at the other end, said first opening and said second opening being connected to one another through the inside of the motor.

#### 10. The rotary brush device of claim 9 wherein the

31. The electric apparatus of claim 22 wherein a brush is provided at a bottom of the floor nozzle between a rotary brush and respective side ends of the floor nozzle.
32. An electric apparatus comprising: an electric blower for air intake, a dust chamber for capturing dust, a floor nozzle provided with an intake chamber having a downwardly facing opening, an intake mouth provided at a wall of said intake chamber and connected by a hose with said electric blower, and the rotary brush device recited in claim 9 disposed in said intake chamber;  
wherein an outside-air intake connected with a first opening is provided at a top part of said floor nozzle, and said intake is disposed on a same side as the first opening in a longitudinal direction of said floor nozzle.
33. An electric apparatus comprising: a pair of front and rear rollers, a floor detector for detecting a type of floor over which the electric apparatus is rolled, a switch operated by engagement with said floor detector, and the rotary brush device recited in claim 9, wherein the rotary brush device is operated by operation of the switch.
34. An electric apparatus comprising: a floor nozzle which incorporates the rotary brush device recited in claim 9 and has an intake chamber with a downwardly facing opening, an electric blower for air intake, a dust chamber for capturing dust, and a handle tiltably attached to said floor nozzle;  
wherein rotation of the cylindrical body of said rotary brush device is halted when said handle is positioned substantially upright.
35. The electric apparatus of claim 34 wherein a controller is provided on a part of the handle for controlling rotation of the cylindrical body of rotary brush device.
36. An electric apparatus comprising: a floor nozzle having disposed therein the rotary brush device recited in claim 9, the floor nozzle having an intake chamber with a downwardly facing opening, an electric blower for air intake, a dust chamber for capturing dust, and a dust detector provided at a part of an air intake path connecting said intake chamber and the electric blower;  
wherein rotation of the cylindrical body of the rotary brush device is controlled in accordance with an output of said dust detector.
37. The rotary brush device of claim 2 wherein a first end of the cylindrical body is journaled by a shaft of the rotor and a second end of the cylindrical body is engaged, via said speed reduction mechanism,
- with the shaft of the rotor.
38. The rotary brush device of claim 1 wherein a first end of the cylindrical body is journaled by a shaft of the rotor and a second end of the cylindrical body is engaged, via said speed reduction mechanism, with the shaft of the rotor.
39. The rotary brush device of claim 1 further comprising a detector sensing either pressure or temperature, the detector is provided adjacent the motor, and a power supply to the motor is controlled in accordance with the detector.
40. The rotary brush device of claim 1 further comprising a detector sensing electric current flowing in the motor, and a power supply to the motor is controlled in accordance with the detector.
41. The rotary brush device of claim 1 wherein one of the agitator and the scrapper is provided on an outer wall of the cylindrical body and having bristles in one of a helical pattern and a V-shaped pattern.
42. An electric apparatus comprising at least one rotary brush device recited in claim 1.
43. An electric apparatus comprising: the rotary brush device of claim 1 further comprising a manual reset type thermo-protector is as a detector for detecting a temperature, and a temperature detecting part of the detector is disposed at a motor side of the apparatus and a reset button of the detector is disposed on an outer face of the apparatus.
44. An electric apparatus comprising: a floor nozzle having an intake chamber connected with an electric blower, and the floor nozzle is provided with a downward facing opening, wherein the intake chamber is provided with the rotary brush device recited in claim 1.
45. The electric apparatus of claim 23 wherein the outside-air intake is provided at a top surface of the floor nozzle.
46. The electric apparatus of claim 23 wherein the electric blower and the intake chamber are connected by at least one hose.
47. The electric apparatus of claim 22 wherein a detector for detecting a pressure is provided, and a power supply to the motor is controlled in accordance with the pressure detected by said detector.
48. An electric apparatus comprising: a pair of front and rear rollers, a floor detector for detecting a type of floor over which the electric apparatus is rolled, a

Fig. 1

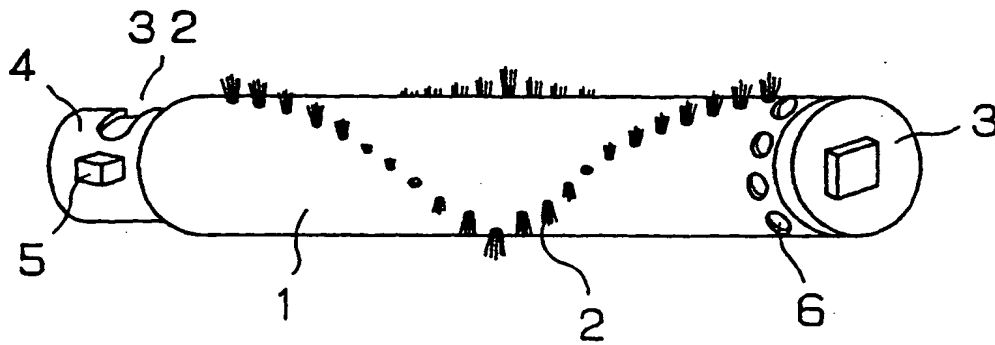


Fig. 3

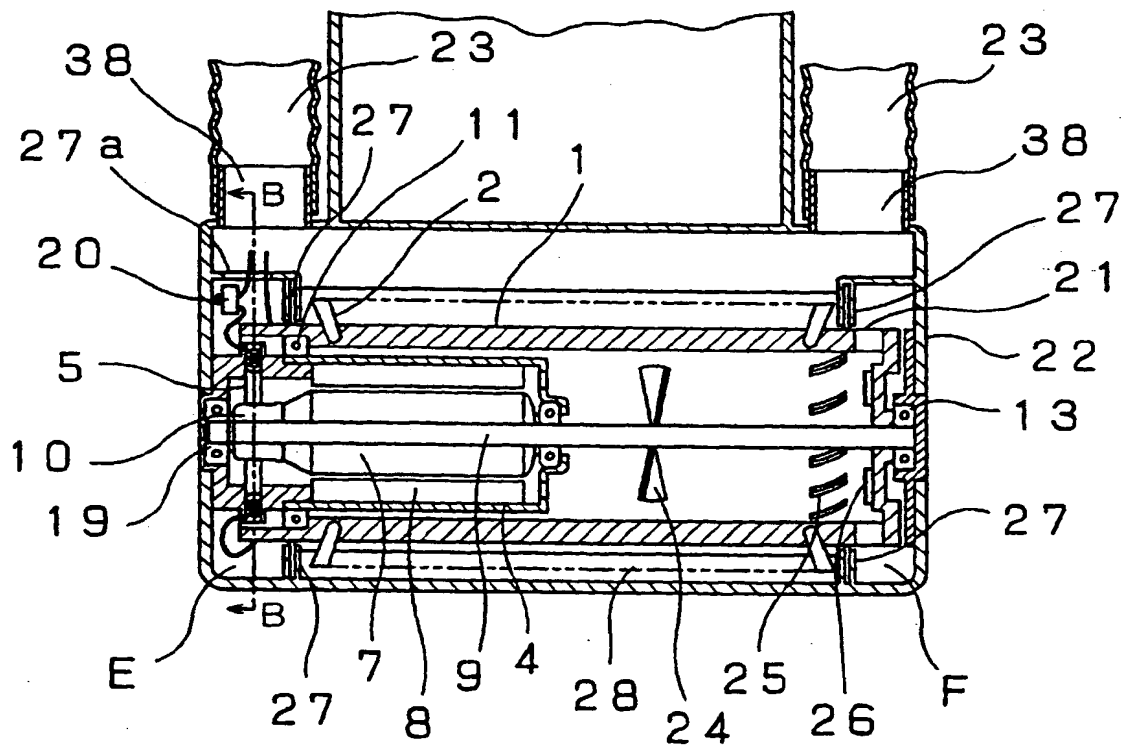


Fig. 5

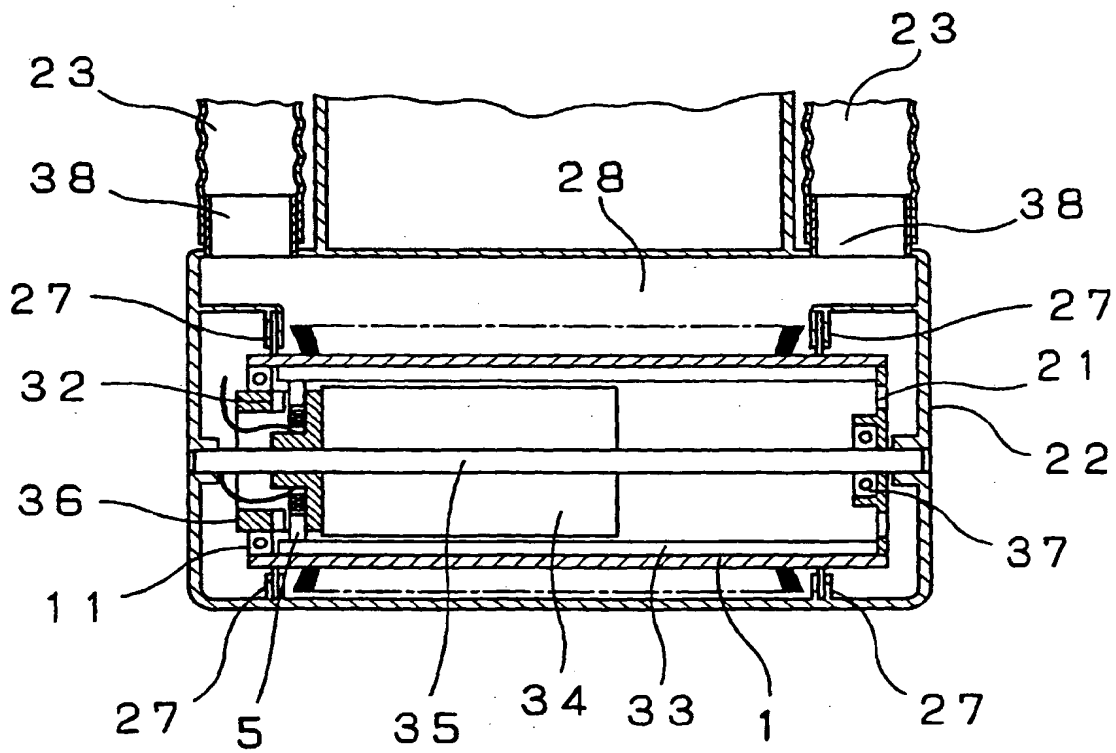


Fig. 7

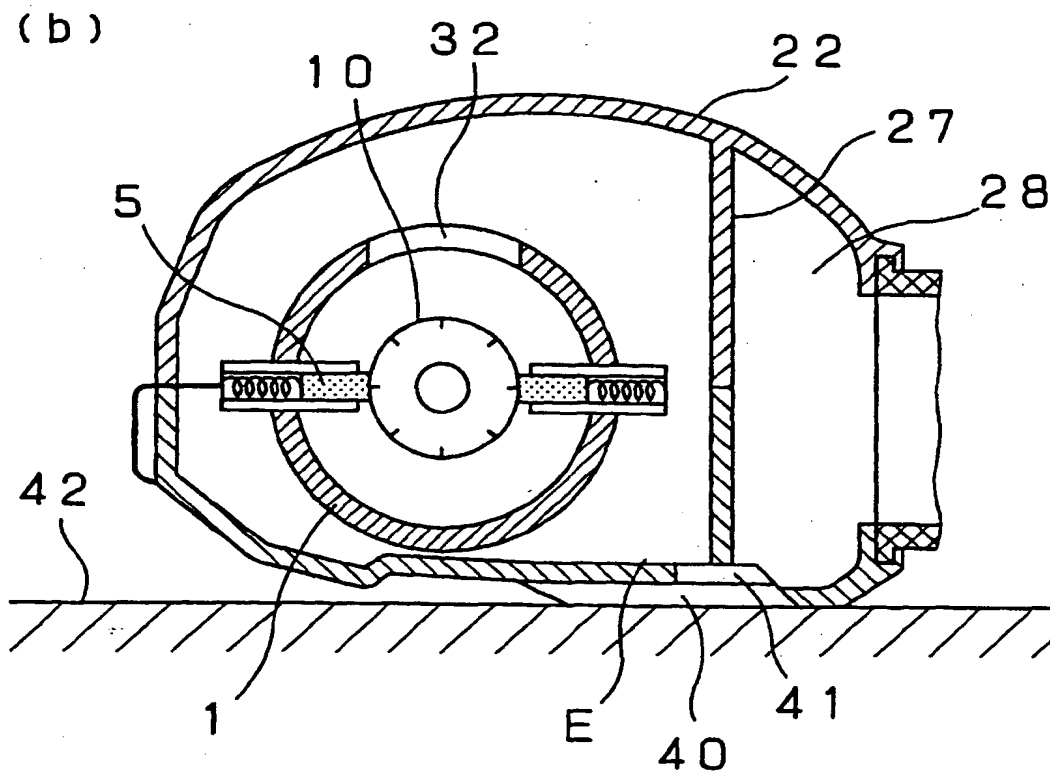
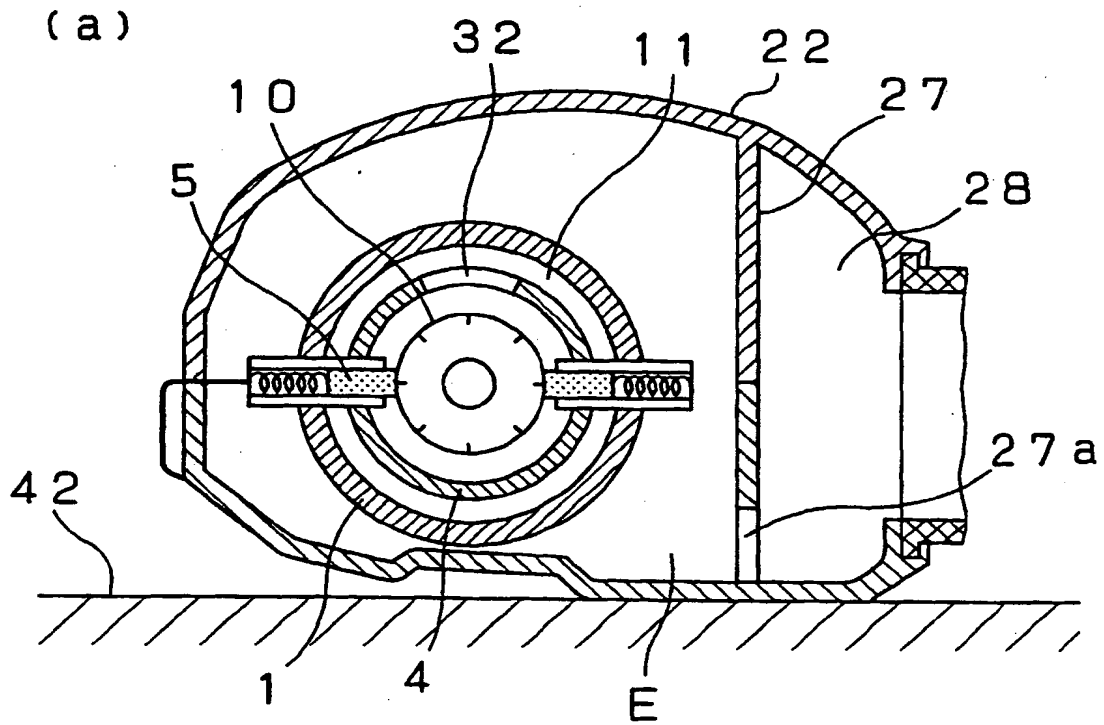




Fig. 9

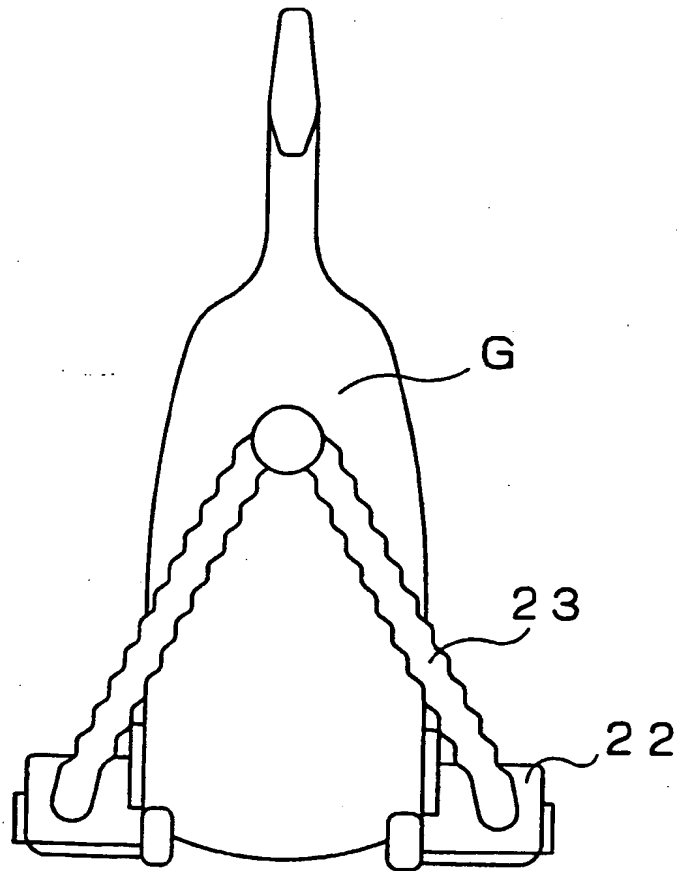


Fig. 11

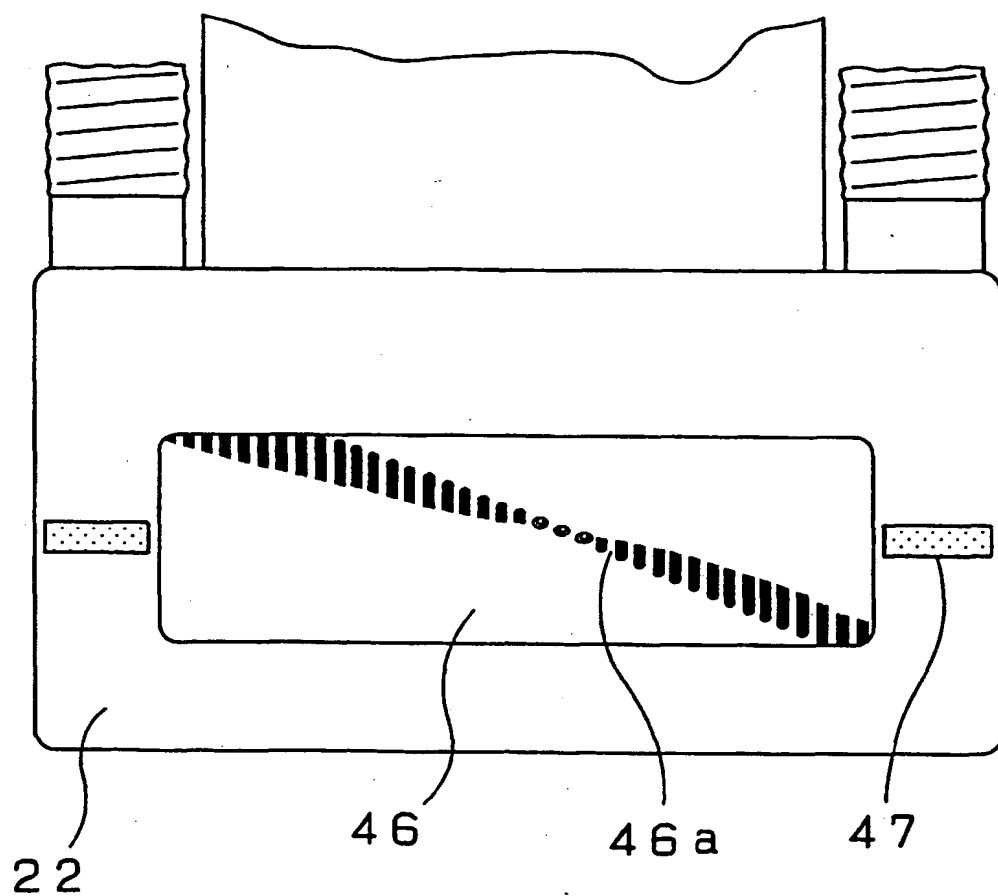
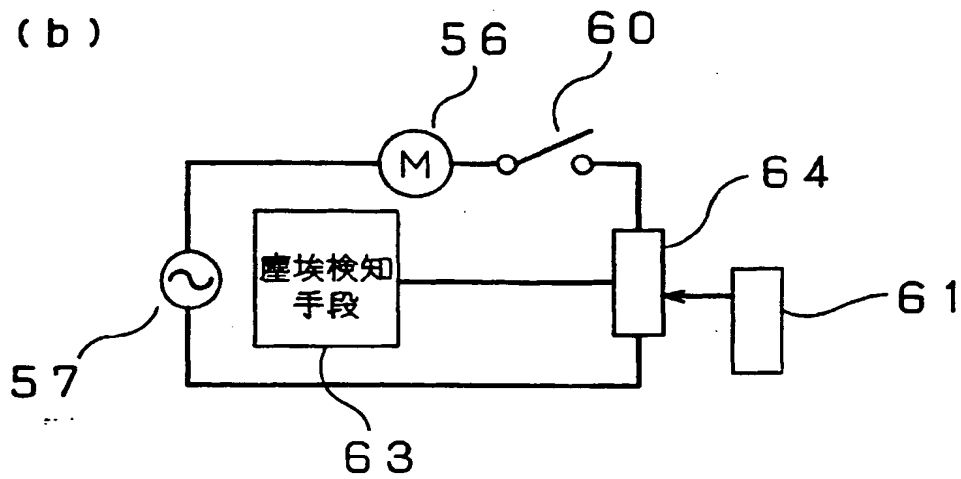
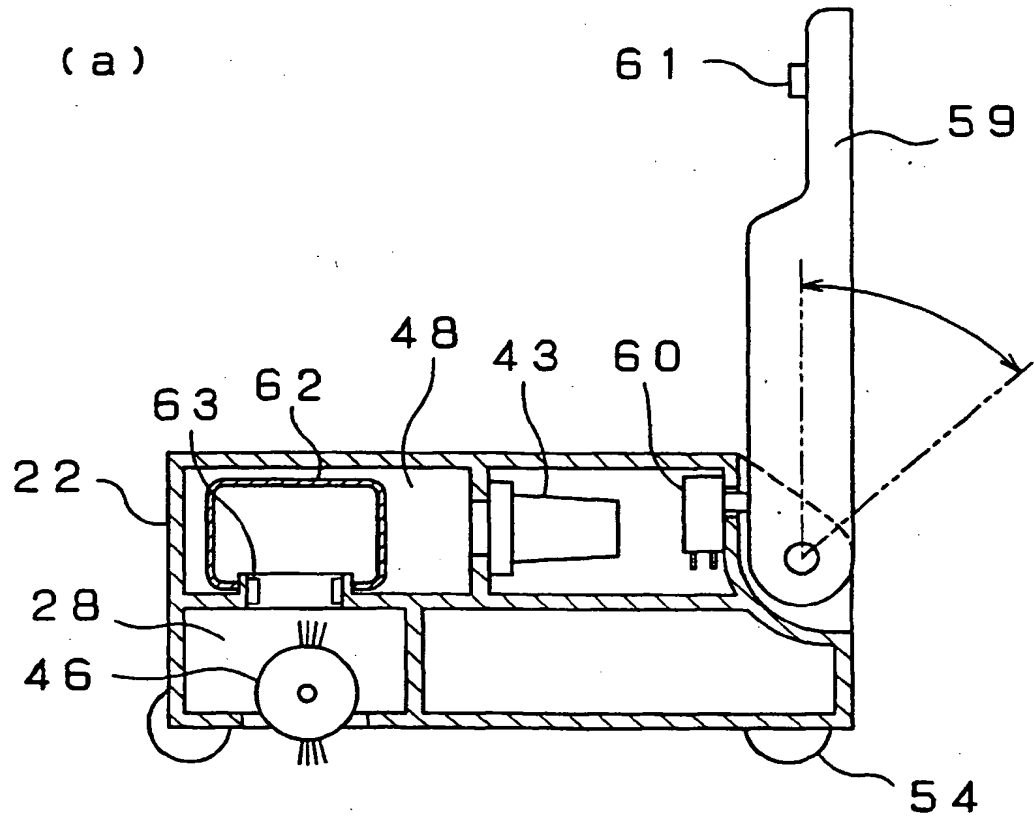


Fig. 13



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(30) Priority: **03.04.1998 US 55020**

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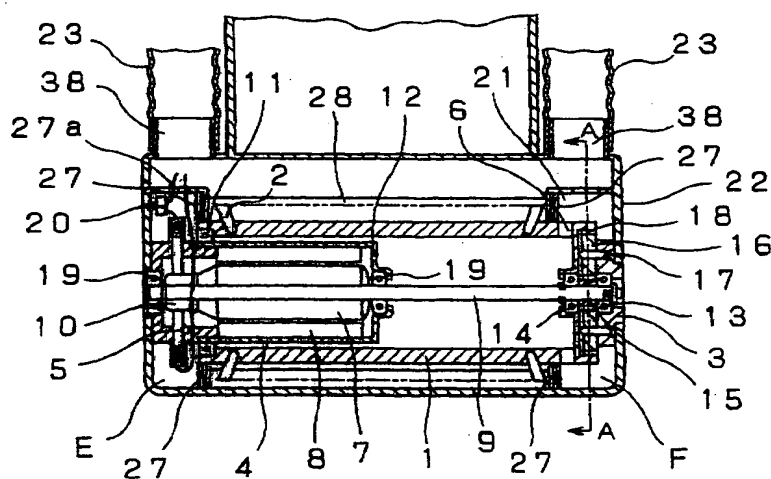
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**Fig. 2**



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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 10 6662

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE 197 06 239 C (DUEPRO AG) 2 April 1998 (1998-04-02) * column 4, line 23-65; figure 4 *	13,14	
A	EP 0 467 347 A (SANYO ELECTRIC CO) 22 January 1992 (1992-01-22) * column 7, line 12 - column 8, line 9 * * column 16, line 35-49; claim 2 *	18,39, 47,48	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			

Place of search

MUNICH

Date of completion of the search

20 December 2001

Examiner

Laue, F

### CATEGORY OF CITED DOCUMENTS

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